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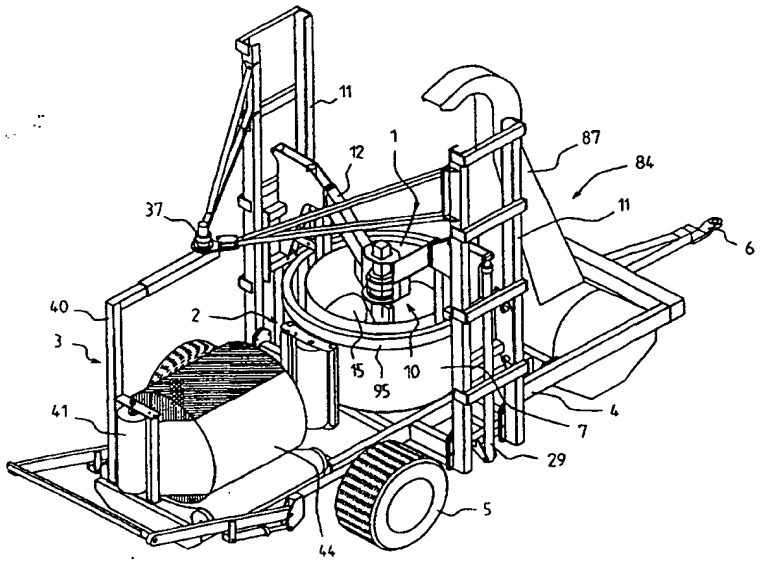
(54) Title: A WRAPPING MACHINE

(57) Abstract

A wrapping machine for wrapping materials, in particular compacted bales (20) of material such as fodder, loose materials and the like with a strip of wrapping material such as plastics film. It comprises a first wrapping station (2) having wrapping means (94) for applying a strip of wrapping around the bale to partially wrap the bale (20) in wrapping material, a second wrapping station (3) having wrapping means (41, 62) for applying a strip of wrapping material around the bale to completely wrap the bale (20) in wrapping material, and transfer means (50) for transferring the partially wrapped bale (20) from the first wrapping station (2) to the second wrapping station (3). The partial wrapping of the bale prevents its disintegration during transfer. The transfer means (50) is swingable, to transfer the bale (20), through approximately 90° from the first wrapping station (2) to the second wrapping station (3). The first wrapping station (2) includes wrapping means comprising a dispenser (94) for dispensing a strip of plastics film, and means for rotating the dispenser, about a substantially vertical axis, around the bale to partially wrap the bale. The second wrapping station (3) includes means, for rotating the bale about a substantially horizontal axis, and at least one dispenser (4), for dispensing a strip of wrapping material and means for rotating the dispenser (41) around the bale as the bale (20) is turned about the horizontal axis. The invention also includes a compaction station (1) having a compactor (10) for compacting loose material into a bale (20), before wrapping. The compactor (10) comprises a compaction chamber (7), open at both ends, means (87) for directing loose material into the chamber (7), a rotating compaction head (15) including at least one roller (13) rotatable over the loose material within the compaction chamber (7), and capable of moving within the compaction chamber (7) as loose material accumulates within the chamber (7) to compact the material in the chamber (7). Preferably, the compaction chamber (7) is moveable upwardly in a vertical direction as the bale (20) is being formed to expose a part of the partially-formed bale (20), and wrapping means (94) are included to wrap an exposed part of the bale (20) with wrapping material as the compaction chamber (7) is raised.



A WRAPPING MACHINE

Field of the Invention

The invention relates to a wrapping machine, in particular to a bale wrapping machine. The invention also concerns a combined compacting and wrapping machine for compacting material into bales and wrapping the bales with plastics film. The invention is particularly concerned with a machine for forming bales of agricultural silage, grain, hay, straw, maize, beet pulp, beet tops, and the like (hereinafter referred to as "fodder") and wrapping the formed bales with a plastics film, which preferably is air tight and water tight. The machine of the invention may also be used for compacting and wrapping general farm and agricultural waste products, such as waste plastics and the like, and for compacting and wrapping other loose materials and objects such as comminuted peat moss, saw dust, wood shavings, wood chippings, brewery waste, bricks, blocks, cartons and the like.

Background of the Invention

It has become conventional practice in agriculture to form harvested fodder into cylindrical-shaped bales, and square or rectangular bales, which are then wrapped in a plastics film. This is particularly suitable method of manufacturing silage because the silage is kept air-tight within the wrapped bale which, typically, is wrapped with up to six plies of plastics. The cylindrically shaped bales are commonly called "big round bales".

In the present method of producing wrapped bale fodder, such as silage, at least three machines are used. Firstly the grass or other fodder for use as silage is cut, in a field, by a cutting machine. A conventional baling machine then traverses the field, picks up the cut grass, compacts it into a round bale, ties it with twine, and deposits it on the ground. A bale wrapping machine then traverses the field, picks up the compacted and tied bales, and wraps the bales with several layers of a plastics film, and drops the wrapped bales on the ground. The wrapped bales are subsequently gathered and brought

mounted on rollers which rotate the bale only about the horizontal axis. In this arrangement there is provided a rotary support arm for the film dispenser which rotates the film dispenser, about a vertical axis, around the bale, while the bale is being turned about a horizontal axis.

The conventional methods of producing wrapped bale fodder as described above suffers from a number of disadvantages. Firstly, it is an expensive operation because of the number of machines, tractors, and manpower utilised. A conventional bale wrapping machine of the kind described above is capable of wrapping about 40 large round bales of fodder per hour. To produce 40 round bales per hour requires the services of two conventional round baling machines, each of which requires a tractor and, a driver for the tractor. Because the conventional baling machines use a pressing and winding system to compact and form the bale of fodder, the density of bale obtained is not particularly high. In other words, the volume or weight of fodder contained in the formed bale is not as high as desired. Furthermore, with conventional bale wrapping machines there is a high degree of overlap of the plastics film resulting in a high cost.

With conventional baling machines it is necessary to tie the bales with twine, or enclose it within netting material as otherwise the bale will break apart upon ejection from the baling machine or during further handling. The necessity to tie the bales in the conventional baling machines adds to the cost of the machine because a tying mechanism must be provided in the machine. For the user there is the additional cost of providing twine or cord.

More particularly, the provision of twine or cord on conventional large round bales is a great inconvenience to the farmer because he must cut off the twine before feeding out the fodder. Also, because the bales are formed by winding the fodder into a cylindrical shape the bale may be unrolled during the feeding out operation, and special machines are used for this purpose, as described in GB 2158111 A. Alternatively the bale is shredded. It is almost impossible to remove all the twine from the bale without breaking or unrolling the bale in some way.

Another disadvantage of conventional baling machines is that they are unable to handle crops which are cut to a short length such as maize silage or short cut grass (i.e. "precision chopped" material), because it is difficult to tie such bales with twine. Also, conventional baling machines have a compaction chamber of a fixed size and are capable of producing a bale of a fixed size only.

The support frame for the bale at the second wrapping station is pivotable from a normally horizontal position, through approximately 90°, to a position in which engagement means on the support frame engage with complementary means on the wrapping platform, and the wrapping platform is pivotally mounted, such that when the support frame is returned to its original horizontal position it causes the wrapping platform to swing from a normally horizontal position, through approximately 90°, to deposit the partially wrapped bale onto the support frame at the second wrapping station

The first wrapping station includes wrapping means comprising a dispenser for dispensing a strip of wrapping material, such as a plastics film, and means for rotating the dispenser, about a substantially vertical axis, around the bale to partially wrap the bale, and the second wrapping station includes means, for rotating the bale about a substantially horizontal axis, and at least one dispenser, for dispensing a strip of wrapping material and means for rotating the dispenser around the bale, as the bale is turned about the horizontal axis.

In another embodiment, the invention provides a combined compacting and wrapping machine for compacting material, such as fodder, loose materials, and the like, into a bale and wrapping the bale with a wrapping material, such as plastics film, comprising a compacting station including a compactor for compacting loose material into a bale and means for moving the compacted bale from the compacting station to at least one wrapping station having means for wrapping a strip of wrapping material, suitably a plastics film, around the bale. The compacting station and wrapping station are combined in a single machine by mounting them on the same chassis or platform.

In one embodiment, the machine includes a first wrapping station where partial wrapping of the compacted bale takes place, a second wrapping station where wrapping is completed, and means for transferring the partially wrapped bale from the first to the second wrapping station.

In another embodiment, the machine includes first wrapping means located at the compaction station for partially wrapping the compacted bale at the compaction station, and transfer means for transferring the bale to a second wrapping station where wrapping is completed.

Preferably, the compactor comprises a compaction chamber, open at the top, means for directing loose material into the chamber, a rotating compaction head including at least one roller rotatable over the loose material within the compaction

material as the compaction chamber is raised. In particular, the top and bottom corner portions of the bale are wrapped at this location. Thus, in this embodiment the first wrapping station is coincident with the compaction station. Transfer means are provided, as described above, for transferring the partially wrapped bale to the second wrapping station.

The invention includes methods of forming and wrapping bales of fodder and other materials comprising the use of apparatus as described above.

Brief Description of the Drawings

Some embodiments of the invention are hereinafter described with reference to the accompanying drawings, wherein:

Figure 1 is a side elevation showing the prior art arrangement for baling and wrapping fodder in the field;
Figures 2 and 3 are rear and front perspective views, respectively, of a first embodiment of a combined compacting and wrapping machine of the invention;
Figures 4 to 8 are side elevations of the machine of Figure 2, at different stages in the wrapping operation;
Figures 9 and 10 are end elevations of Figures 6 and 7, respectively.
Figure 11 is a rear perspective view of the machine of Figure 8;
Figure 12 is a side elevation of the machine showing transfer of a bale to a second wrapping station;
Figures 13 is a side elevation of details of a transfer mechanism;
Figure 14 is a plan view of a wrapping platform of Figure 13;
Figures 15 and 16 are a side elevation and rear perspective view, respectively, showing the wrapping of a bale at the second wrapping station;
Figure 17 is a side elevation showing details of a tipping mechanism;
Figure 18 shows a detail of the drive means for a rotating compaction head;
Figures 19 and 20 show details of modifications to the rotating compaction head;
Figure 21 shows a side elevation of a second embodiment of a combined baling and wrapping machine of the invention showing one method of use;
Figure 22 is a view similar to that of Figure 21 showing an alternative method of use;
Figure 23 is a perspective view of the second embodiment of a combined agricultural baling and wrapping machine of the invention;
Figure 24 is a side elevation of the machine of Figure 23;
Figure 25 is a plan view of the machine of Figure 24;

of the bale wrapping machine 74 is used, there is a requirement to have two separate baling machines 71 and tractors 72.

A first embodiment of a combined compacting and wrapping machine of the invention, and its method of use, is illustrated generally in Figures 2 to 20. The machine, which is towed by a tractor comprises a compacting station 1, a first wrapping station 2, and a second wrapping and tipping station 3. The compacting station 1 includes a vertical compactor 10.

In the embodiment of the invention as shown in Figures 2 and 3, the machine of the invention incorporates an integral forage harvester 84. This is similar to that shown in Figure 22 and comprises an array of tines 85 for picking-up the silage 70, in well known manner. The silage is fed by an auger 86 to a chopping unit 87, where the silage is cut into small pieces by an array of rotating blades which rotate relative to fixed blades. The precision chopped silage is blown by a fan through a chute 87 which feeds it directly to the open top of a compaction chamber 7. Thereafter the chopped silage is baled and wrapped as hereinafter described.

The first embodiment of a combined compacting and wrapping machine of the invention comprises a compacting station 1, a first wrapping station 2, and a second wrapping station 3. The stations 1, 2 and 3 and the component parts thereof as described below are all mounted on a chassis 4 having a pair of wheels 5. The chassis has a hitch 6, at a front end thereof, for attachment to a tractor 80 (see Figure 22). In this embodiment the compacting station 1 and the first wrapping station 2 are located coincident with each other.

Referring particularly to Figures 2 and 3, the compacting station 1 comprises a vertical compacting chamber 7. The chamber 7 is substantially cylindrical in shape with an open top 8. It is also open at the bottom.

A compactor 10 is positioned in the open top 8 of the compacting chamber 7. The compactor 10 is supported on a pair of vertical support columns 11 mounted to each side of the chassis 4. A pair of downwardly inclined support arms 12 are each mounted on a respective column 11 and each is slideable in a vertical direction along the columns 11 by means of hydraulic rams 29. The supports arms 12 carry a rotating compaction head 15 consisting of rollers 13 formed with cleats 14 on the surface thereof (see Figures 18 to 20).

In this first embodiment the cylindrical compaction chamber 7 is moveable in a vertical plane, and the first wrapping station 2 is disposed coincident with the compaction chamber 7 to wrap the bale 20 as it is exposed by raising of the chamber 7.

As shown in Figures 2 and 3, the cylindrical compaction chamber 7, which is open at top and bottom, is attached to the arms 12 and is moveable vertically on the columns 11 by means of the hydraulic rams 29. In its lowered position the chamber 7 fits over a wrapping platform 30 of the first wrapping station (see Figure 4). The platform 30 is fixed, and is circular in plan and in the lowermost position of the chamber 7 it fits within the bottom of the chamber 7.

In this embodiment a first bale wrapping means is provided at this location. As shown in Figure 4, this comprises a vertically disposed support arm 93 which carries a film dispenser 94. The support arm 93 rotates, in a circular path, around the circumference of the chamber 7. The arm 93 is fixed to a circular ring 95 which is rotatable on rollers (not shown) attached to the outer wall of the chamber 7, adjacent the top thereof. A belt or chain (not shown), driven by a hydraulic motor, runs around the outer circumference of the circular ring 95 causing it to rotate. The circular ring 95 thus carries the arm 93 and film dispenser 94 in a circular path around the outside of the chamber 7.

In use, loose cut grass, silage, or other fodder is blown directly from a separate forage harvester 81 (see Figure 21), or preferably, by an integral forage harvester 84 (see Figure 2) of the machine of the invention, into the compaction chamber 7 where it is pressed down by the rotating compaction head 15. The compaction head 15 rotates, about the vertical axis, around the inside perimeter of the chamber 7 with the cleated rollers 13 constantly rolling over the top surface of the grass as it is compacted and builds up in the cylinder to form a bale 20. Simultaneously the rotating compaction head 15, and the chamber 7, are moved by the hydraulic rams 29 vertically upwardly along columns 11 as the grass builds up in the compaction chamber 7 (see Figures 9 and 10 which shows the compactor head 15 within the chamber 7). The vertical movement of the rotating compaction head 15 is hydraulically restricted, and acts to exert a downward force on the bale of fodder being formed so that efficient compaction of the fodder to a high density is achieved. The hydraulic ram pressure on the compaction head 15 is adjustable by either hydraulic of electro-hydraulic means. When a pre-set compaction pressure on the compaction head 15 is achieved a signal is sent to lift the hydraulic ram to raise the compaction head 15 until the hydraulic pressure on the compactor head 15 is again below the pre-set value, whereupon the ram presses the compaction head 15

distance, above the lower edge of the chamber 7 such that a portion of the partly-formed bale 20 is within the chamber (see Figure 9).

Referring now to Figures 7 and 10, these illustrate the position at the end of the compaction step. The bale 20 is fully formed, but the rotating head 15 remains on the top surface of the bale 20. However, the chamber 7 has been lifted by a pair of hydraulic rams 105. This reduces the risk of damage to the bale 20 as the chamber 7 is lifted clear of the bale 20.

Figure 8 shows the position when the chamber 7 and rotating head 15 are both raised above the formed and partially wrapped bale 20.

All of the bale 20 has now been wrapped except for the end portions. However, the film 44 has wrapped around the top and bottom corners of the bale as shown most clearly in Figure 13. The partly-wrapped bale is now transferred to the second wrapping station 3. This is achieved by transfer means 50 described below. The transfer means 50 tilts the bale 20 onto a conveyor belt 63 where wrapping of the bale is completed by a rotary film dispenser 41 as described below.

To reduce the height to which the chamber 7 needs to be lifted on the columns 11 to allow clearance of the bale 20 during the tilting movement (shown in Figure 8) a top portion 88 of the chute 87 is pivoted to a lower part of the chute 87 by a pivot 92. A hydraulic ram 98 is connected between the chute 87 and the top portion 88. Operation of the ram 98 causes the portion 88 to tilt forwards to provide clearance for the bale, which is now transferred, by transfer means 50, to the second wrapping station 3.

The transfer means 50 is adapted to turn the partly wrapped bale 20 through approximately 90° onto a second wrapping platform where the ends of the bale 20 are wrapped in plastics film. At the first wrapping station the bale 20 stands on its end with its longitudinal axis in a vertical position. It is turned so that its longitudinal axis lies in a horizontal plane, coaxially with the longitudinal axis of the machine. A similar transfer means is utilised in the second embodiment and is illustrated e.g. in Figures 31 and 34 to 36.

Referring to Figures. 8, 11 and 12 the transfer means 50 comprises a normally horizontally-disposed frame 51 having an upright 52, which carries a hook 54 pivotally connected thereto. The frame 51 carries a conveyor support frame 56 which is pivotally connected thereto by brackets 58. A pair of spaced driven belt rollers 61, 62 are

110 is pin-jointed to pivot 111 at one end, at its other end it is pivotally connected to the bottom of a pivot arm 107. Arm 107 pivots, near its centre, about pivot 112 on a bracket attached to the underside of part 109. The other (top) end of pivot arm 107 is pin-jointed to one end of a short strut 113, The other end of the strut 113 is pin-jointed to the part 108.

The pivot 111 is located rearwardly of pivot 53. Thus when the plate 30 is moved through 90° as shown in Figure 14, this causes the linkage struts/arms 110, 107 and 113 to move which, in turn, cause the part 108 to slide relative to part 109. This reduces the diameter of the wrapping platform 30 (to the size shown in broken line in Figure 14). Thus, when the arm 67 and platform 30 are retracted from the vertical position back to the horizontal, the reduction in the overall size of platform 30 enables it to detach more easily from the portions of the wrapping film 44 which overlap the corners of the bale 20 and the platform 30.

As the platform 30 returns to its normal horizontal position the linkage described above operates in the opposite direction to extend the overlapping parts 108, 109 such that the platform 30 assumes its full size. It will be appreciated that the linkage may be replaced by hydraulic means to cause relative movement of parts 108, 109.

Figures 15 and 16 show the next stage in the baling and wrapping operation. The formed bale 20 is undergoing wrapping at the second wrapping station 3, while the compaction chamber 7 has been lowered to its lowermost position to begin compaction of a new bale.

The means for wrapping the bale 20 at the second wrapping station 3 comprises a wrapping dispenser 41 containing a roll of plastics film in well known manner. This is carried by a support arrangement comprising fixed struts 36 which extend rearwardly from the top of the columns 11 and support a hydraulic motor 37 which drives a rotary arm 38 in a circular path around the endless belt 63. the rotary arm 38 is telescopically extendible in a horizontal plane. At least one vertically disposed wrapping arm 40 depends downwardly from the end of the rotary arm 38. The dispenser 41 is mounted on the end of this arm. Optionally, as shown in Figure 15 two film dispensers 41, disposed at 180° to each other; may be used. These rotate in unison around the bale 20.

The film dispenser 41 is of well known construction and may include a pretensioning unit through which the plastics film is fed and stretched. The film

A second embodiment of the invention is illustrated in Figures 21 to 39. This embodiment also includes a compacting station 1, a first wrapping station 2 and a second wrapping station 3. However, unlike the previous embodiment the first wrapping station 2 is located rearwardly of the compaction chamber 1.

The compacting station 1 includes a vertical compactor 10 and a hopper 9 for feeding material to the compactor 10. However, in this embodiment the compaction chamber 7 is not raised vertically, as in the previous embodiment, but moves horizontally as described below.

In a typical use of this embodiment a conventional forage harvester 81, for example of the type marketed under the tradename "Tarup", or model "FCT850" as sold by J.F. Farm Machinery is used in conjunction with the machine of the invention. Grass, or other suitable forage crop, is cut in the field by a mower and left to wilt for a day or so. The forage harvester 81, which is towed by a tractor 82, picks up the cut grass (silage), precision cuts the silage into short lengths and blows the chopped silage through a feeding chute 83 into the hopper 9 of the compacting station of the invention. The precision cut silage is then baled and wrapped as hereinafter described. With this arrangement the forage harvester 81 travels in tandem with the machine of the invention.

Alternatively, as shown in Figure 22 the machine incorporates an integral forage harvester 84 as described in the previous embodiment.

Referring now to Figures 23 to 26, as in the previous embodiment the compaction chamber 7 is vertically oriented, is cylindrical in shape, and has an open top 8. The hopper 9 is mounted above the open top 8 and feeds cut grain, precision chopped silage, and other material to be baled into the chamber.

In this embodiment, a single vertical support column 11 is mounted at the front of the machine. A downwardly inclined support arm 12 is mounted on the column 11 and is slideable in vertical direction along the column by means of a hydraulic ram. The support arm 12 carries, at its lower end a compaction head 15 having two rollers 13. The compaction head 15 operates as described above, in relation to the first embodiment, and like reference numerals denote like parts.

Material to be baled is directed into the compaction chamber 7 by the hopper 9 and it is compressed by the compaction head 15 as described above.

the doors 23. Filling of the compaction chamber 7 can then recommence to form a second bale 20 of fodder.

At the same time wrapping of the first bale 20 commences at the first wrapping station 2.

As shown in figures 31 and 33 the wrapping station 2 comprises a horizontally disposed wrapping platform 30 which has bevelled edges, to facilitate the wrapping of the lower edges and corners of the bale 20. A hydraulic ram 31 is positioned below the platform 30 and is adapted to raise the platform 30 upwardly during the wrapping operation (see Figure 33), again facilitating the wrapping of the bale. The diameter of the platform 30 is less than the diameter of the bale 20 so as to expose the edge of the bale for wrapping. For example, the diameter of the platform 30 may be 1.00m. while the diameter of the bale is 1.04m.

The means for wrapping the bale 20 with a plastics film comprises a vertical support member 35 positioned to one side of the machine (see Figures 25, 26 and 27) and approximately between the first wrapping station 1 and the second wrapping station 2. A swinging arm 36 is pivotally mounted on , and extends horizontally from, the support member 35 near the top thereof. The arm 36 is swingable, through approximately 90°, from the position shown in Figure 31 (as outlined in full lines in Figure 25) to the position shown in Figure 37 (as outlined in broken lines in Figure 25). Thus, it can be swung, by hydraulically operable means, from the first wrapping station 2 to the second wrapping station 3.

As shown more particularly in Figures 30 and 31, a rotatable hydraulic drive member 37 is mounted on the end of the swingable arm 36. This carries a rotary support arm 38 which is rotatable about a vertical axis defined by the drive member 37. A vertically disposed wrapping arm 40 depends downwardly from the end of the rotary support arm 38. The wrapping arm 40 has a dispenser 41 of plastics film rotatably mounted on the lower end thereof. The hydraulic drive member 37 can thus cause the film dispenser 41 to rotate around the bale 20 along the circular path indicated by the line 42 in Figure 6.

The film dispenser 41 is of well known construction and may include a pretensioning unit through which the plastics film is fed and stretched. The film dispenser may include a cut and start device for severing the film at the end of wrapping.

bale at the first wrapping station suffices to hold the bale together. However, if rotation of the bale were to be effected to achieve wrapping, as in a conventional wrapping machine, it is likely that the bale would fall apart at this stage.

Thus, no rotation of the bale takes place at the first wrapping station. Instead, after wrapping of the circumference of the bale at the first wrapping station 2, the bale is transferred, by transfer means 50, to the second wrapping station 3.

The transfer means 50 turns the partly wrapped bale 20 through approximately 90° onto a second wrapping platform where the ends of the bale 20 are wrapped in plastics film. At the first wrapping station the bale stands on its end with its longitudinal axis in a vertical position. It is turned so that its longitudinal axis lies in a horizontal plane, coaxially with the longitudinal axis of the machine, on the endless belt 63. The transfer means 50 is the same as that described above in relation to the first embodiment and it operates in the same way. Like referenced numerals in the drawings denote like parts.

As the bale 20 is transferred onto the endless belt 63, simultaneously the swinging arm 36 of the wrapping means is swung over to the second wrapping station 3 as shown in Figure 37 (illustrated by broken line in Figure 25). The wrapping dispenser 41 is then operated, as before, to wrap the ends 27 of the bale 20 with plastics film. The film dispenser 41 is caused to rotate around the bale 20 along the path 43 indicated by broken lines in Fig. 25. Simultaneously, the endless belt 63 is driven to rotate the bale 20 about its longitudinal axis to effect a full wrapping of the bale with at least two layers of film, in well known manner.

When the bale 20 is fully wrapped it is tipped form the machine as shown in Figure 19. This is achieved by means of a ram 60 which causes the support frame 56 to pivot about a pivot 69 on the frame 51. A tipping arm 68 is optionally provided on the end of the support frame 56. The arm 68 is slideable in a socket 65. As the frame 56 tilts the arm 68 is caused to extend, by means of either a mechanical linkage or hydraulic ram, to partly support the bale during tilting.

Modifications of the machine described above are shown in Figures 40 to 41, where like reference numerals denote like parts.

Figure 40 illustrates a modification of the operation of the transfer means 50 for transferring the partly-wrapped bale from the first wrapping station 2 to the second

Other modifications may be made to the machines described above. For example, the integral forage harvester may be wider than that shown in the drawings to increase output. Also, where the forage harvester is integral with the machine of the invention, it may be detachably secured to the front of the machine in well known manner. Thus, the forage harvester could be unhooked from the machine of the invention for use for other purposes. Also the machine of the invention may include a trailer connected to the rear of the machine so that the fully wrapped bales may be tipped directly onto the trailer instead of onto the ground.

In the above description, the compacting chamber is of cylindrical shape to produce cylindrical bales 20. However, it will be appreciated that different shaped compacting chambers may be used, e.g. rectangular or square shaped. In that case, the second wrapping station may be adapted to wrap square bales e.g. by incorporating the invention of EP 539549 and IE S970777

The machine and method of the invention has a number of advantages over existing bale wrapping system, for example:

(1) The new machine and method handles much shorter grass than conventional machines, this is a big advantage when the silage is incorporated into a diet using a diet mixer machine. The shorter material makes a much more homogenous mix.

(2) The system of the invention will handle maize silage. At present maize silage can only be made in a pit as conventional balers and wrappers cannot handle it. Indeed the invention enables the baling of all fine particulate material, e.g. precision chopped material of a particle size or length or from 15 to 50mm. Previously, it has been difficult to bale such materials.

(3) No twine is required on the bales and so they are much easier to feed. It is very time consuming with the conventional system to cut the twine off bales before feeding.

(4) The baler system of the invention produces very high density bales, for example up to twice the density of existing soft centered bales. This reduces the cost of plastic per unit weight of silage by as much as 50%. This makes bale wrapping far more cost effective so that it can compete

Transfer means (not shown) are provided for pivoting the platforms 130 and 121, through approximately 90°, to swing a partly-wrapped bale from platform 130 onto platform 121. The transfer means is constructed and operates as described above in relation to the first and second embodiments, e.g. as shown in Figures 31 and 34 to 37.

Means for wrapping the bale 20 with plastics film comprises a vertical support column 35 which carries a film dispenser 41 which may be swung from the first wrapping station 2 to the second wrapping station 3. The wrapping means is constructed and operates as described above in relation to Figures 25, 26, 27 and like reference numerals are used to denote like parts.

In use an unwrapped bale 20 of bricks is placed on wrapping platform 130 as shown in Figure 43, e.g. by means of a grab. The wrapping means is operated to wrap the side walls and corners of the bale with plastics film as previously described. The partially wrapped bale is then transferred, through 90°, by the transfer means 50 to the second wrapping platform 121 as shown in Figure 44. This exposes the bottom and top walls of the bale 20 which are then wrapped as shown in Figure 45.

In an alternative embodiment as shown in Figures 46 and 47, the second wrapping platform 121 is replaced by an endless belt 63 which rotates about rollers 61 and 62 . This turns the bale about its axis during the wrapping process as described above in relation to the previous embodiments. It is constructed and operates as previously described and like reference numerals denote like parts.

From the foregoing, it will be apparent that numerous modifications and variations can be effected without departing from the true spirit and scope of the novel concept of the present invention. It will be appreciated that the present disclosure is intended to set forth exemplifications of the invention which are not intended to limit the invention to the specific embodiments illustrated. The disclosure is intended to cover by the appended claims all such modifications as fall within the scope of the claims.

Where technical features mentioned in any claim are followed by reference signs, these reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

5. A wrapping machine as claimed in any of the preceding claims which includes a compaction station (1) having a compactor (10) for compacting loose material into a bale (20).

6. A combined compacting and wrapping machine as claimed in claim 5 characterised in that it includes first wrapping means (94) located at the compaction station (1) for partially wrapping the compacted bale at the compaction station (1), and transfer means (50) for transferring the partially wrapped bale (20) to a second wrapping station where wrapping is completed.

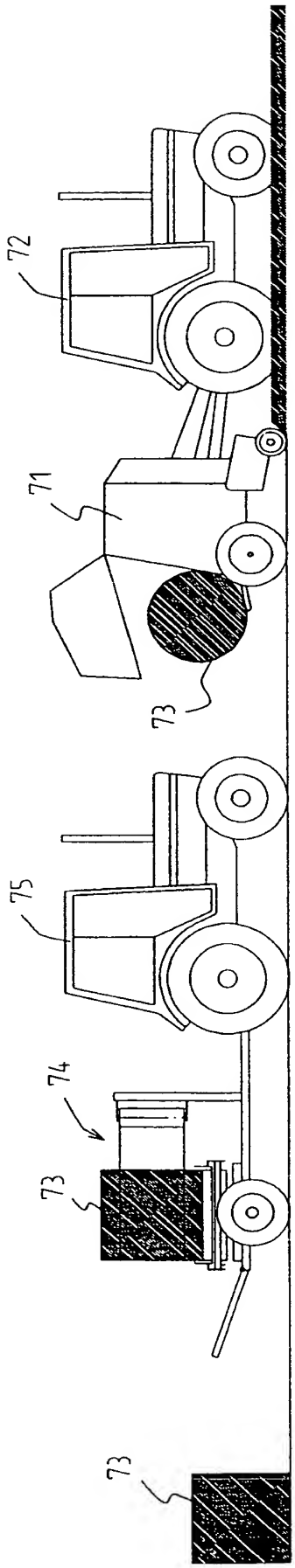
7. A machine as claimed in claim 5 or claim 6 characterised in that the compactor (10) comprises a compaction chamber (7), open at the top, means (87) for directing loose material into the chamber (7), a rotating compaction head (15) including at least one roller (13) rotatable over the loose material within the compaction chamber (7) , and capable of moving within the compaction chamber (7) as loose material accumulates within the chamber (7) to compact the material in the chamber (7).

8. A machine as claimed in claim 7 characterised in that the compaction chamber is vertically oriented, and the rotating compaction head (15) extends into the open top (8) of the compaction chamber (7) and is moveable vertically within the chamber (7).

9. A machine as claimed in claim 7 or 8 characterised in that the compaction chamber (7) is open at the top and bottom and is moveable upwardly in a vertical direction as the bale (20) is being formed to expose a part of the partially-formed bale(20), and wrapping means (94) are included to wrap an exposed part of the bale (20) with wrapping material as the compaction chamber (7) is raised.

10. A machine as claimed in claim 8, characterised in that the wrapping means comprises a film dispenser (94) which is mounted for rotation around the outer surface of the compaction chamber (7) and is moveable upwardly together with the chamber (7) such that it may dispense and continually wrap the bale (20) as it becomes exposed as the compaction chamber (7) is raised.

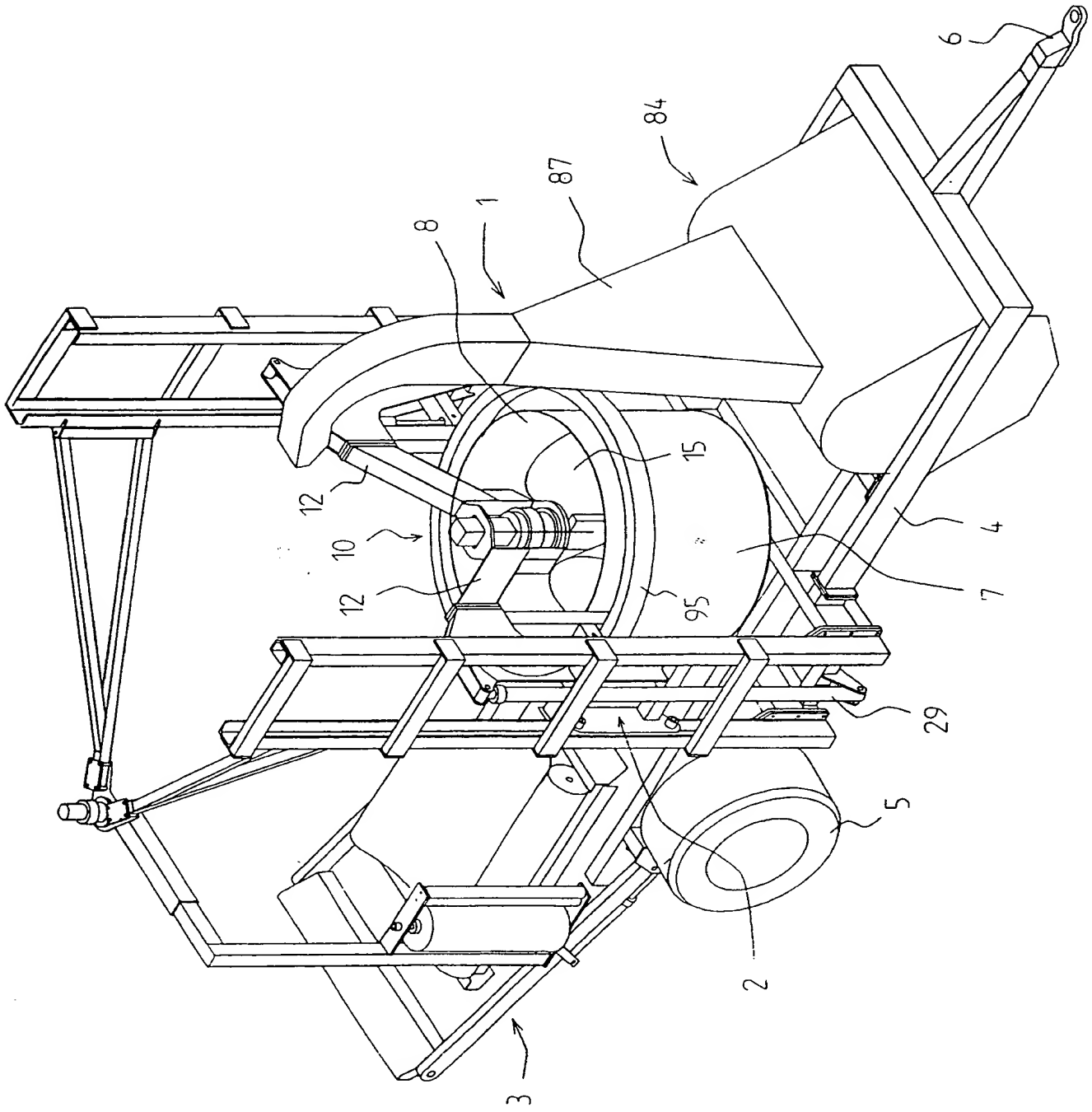
11. A machine as claimed in claim 5, characterised in that the machine includes means for moving the compacted bale (20) from the compacting station (1) to a first



[PRIOR ART]

Fig. 1

Fig. 3



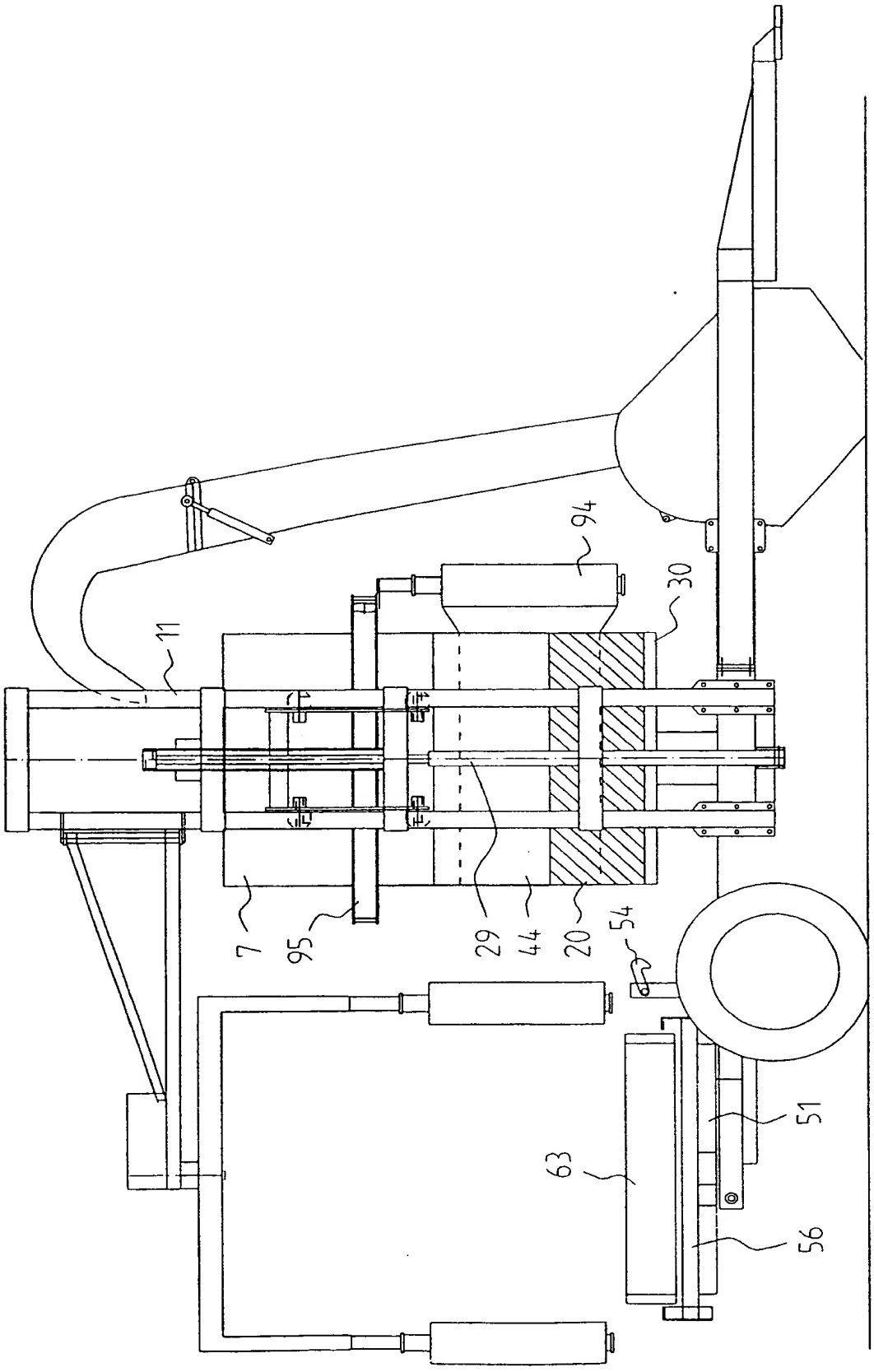


Fig. 5

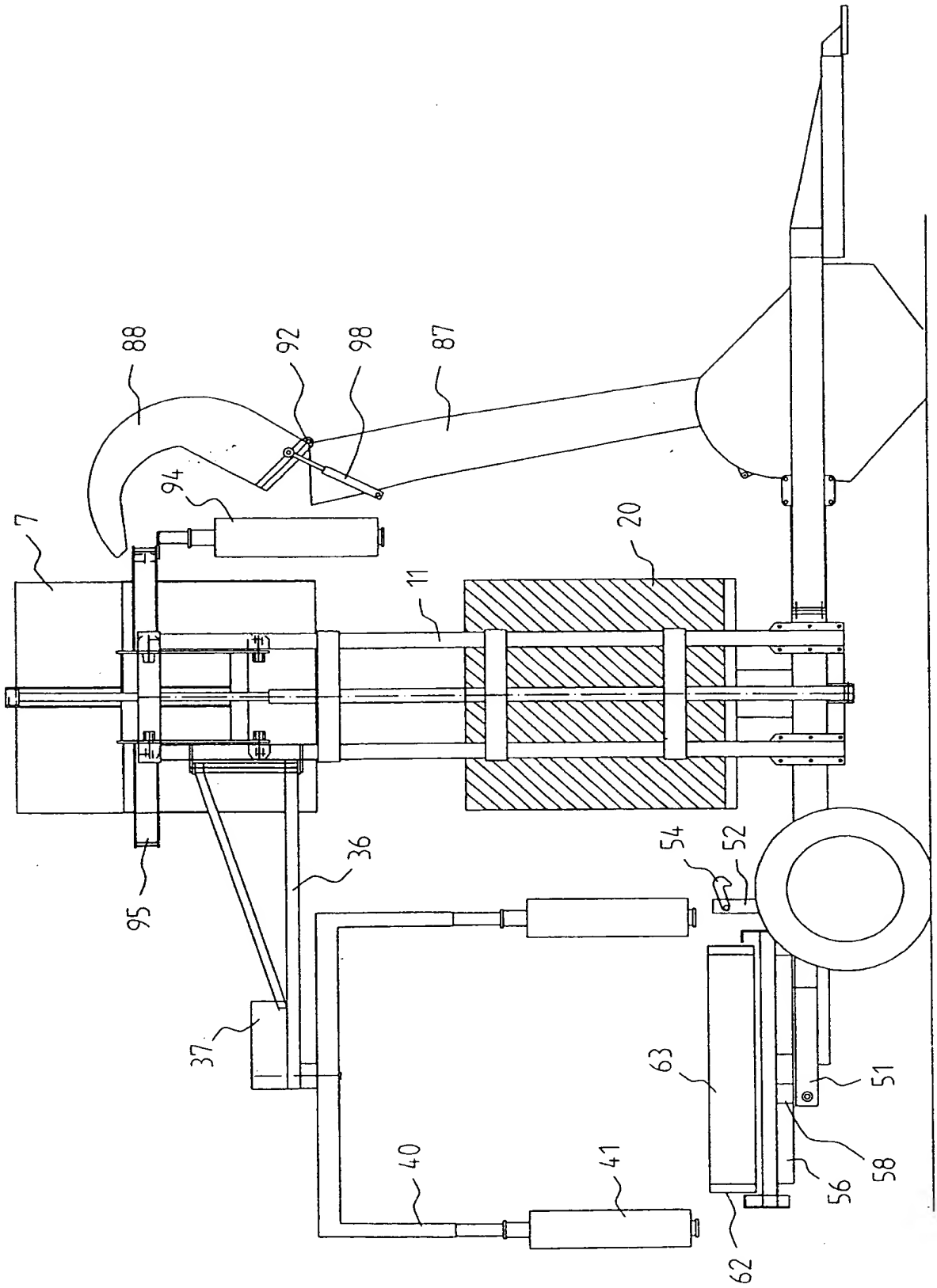


Fig. 8

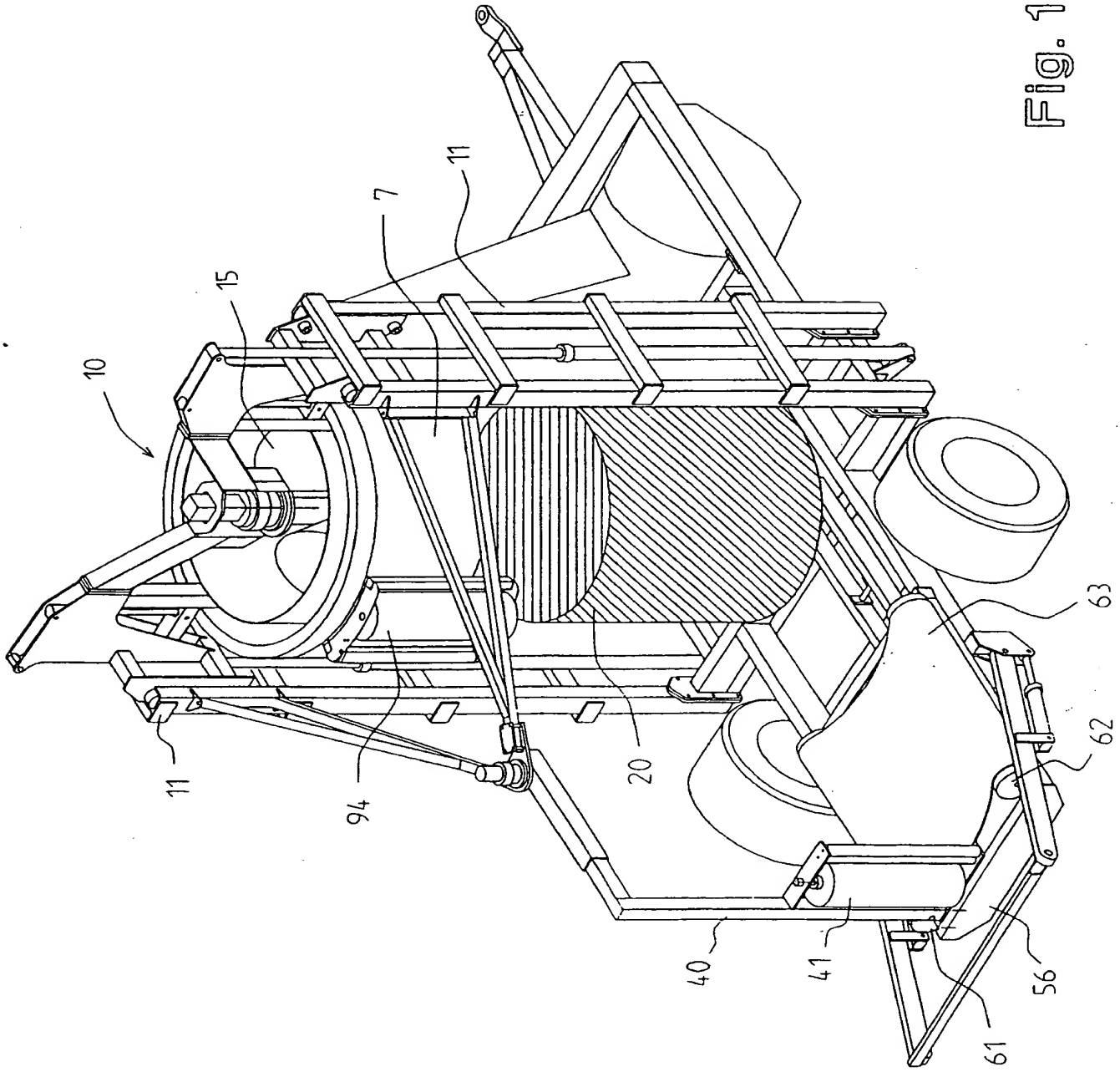


Fig. 11

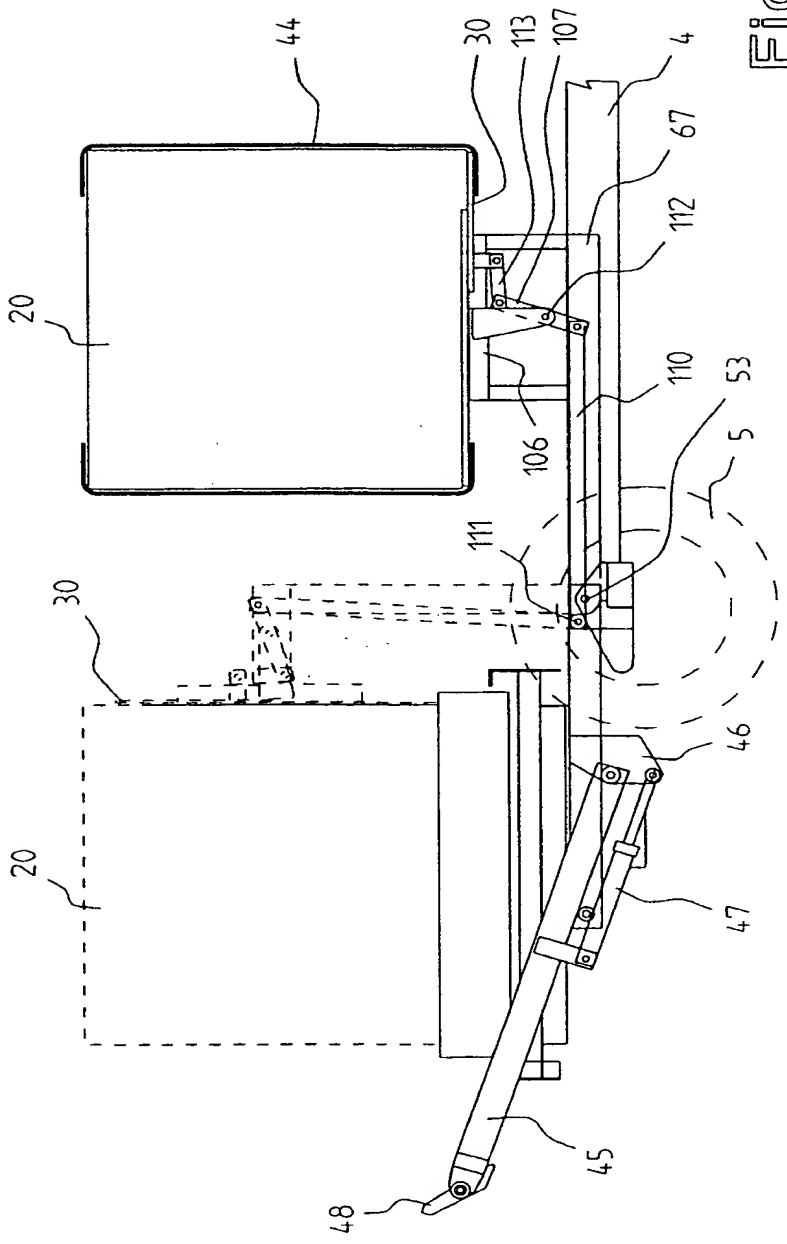


Fig. 13

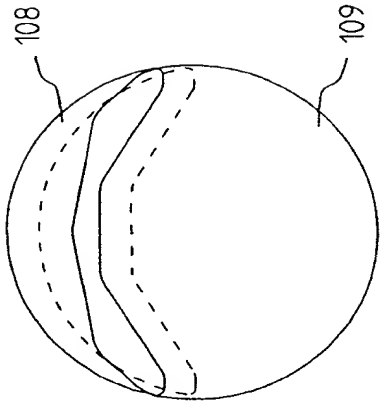


Fig. 14

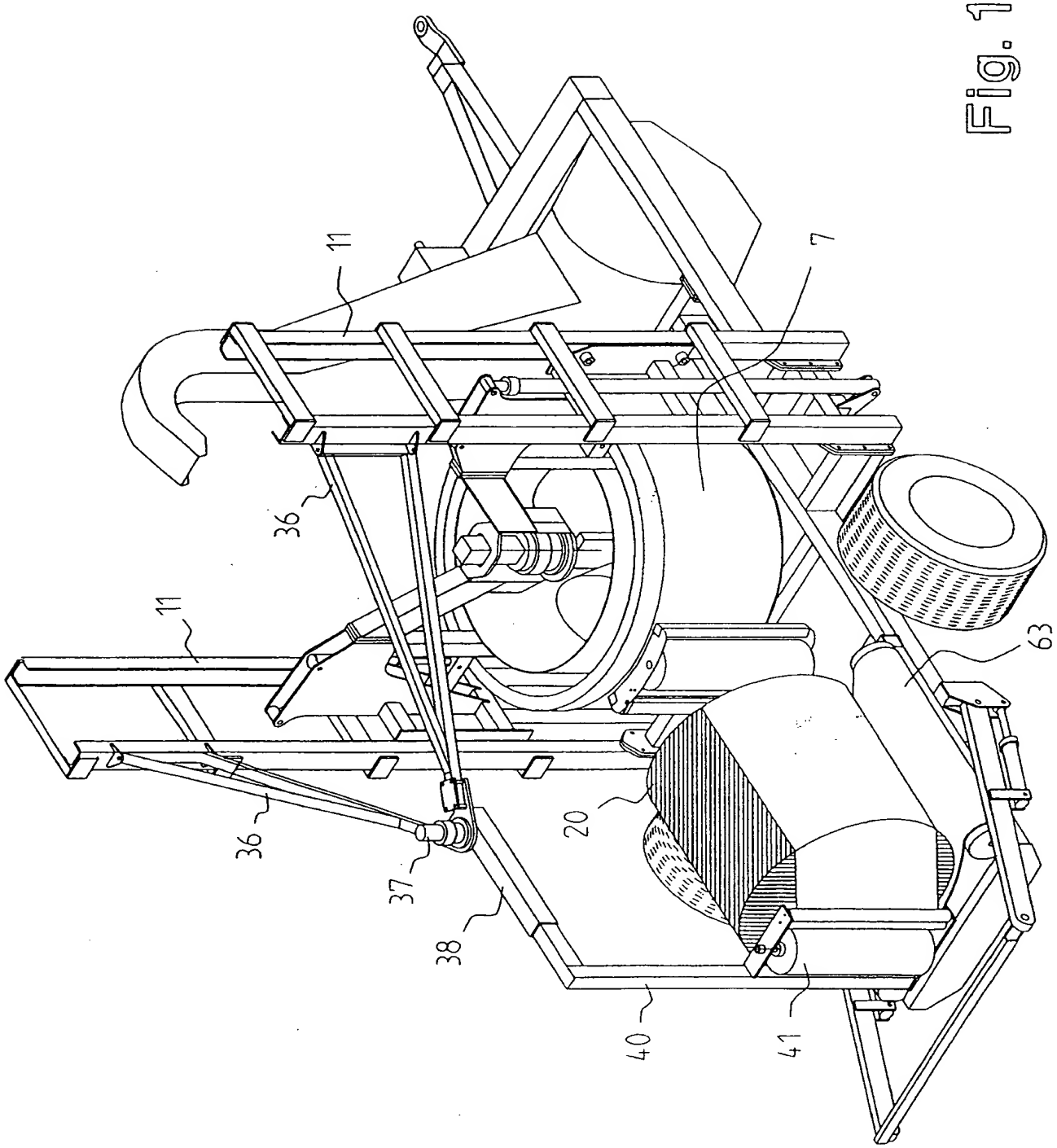


Fig. 16

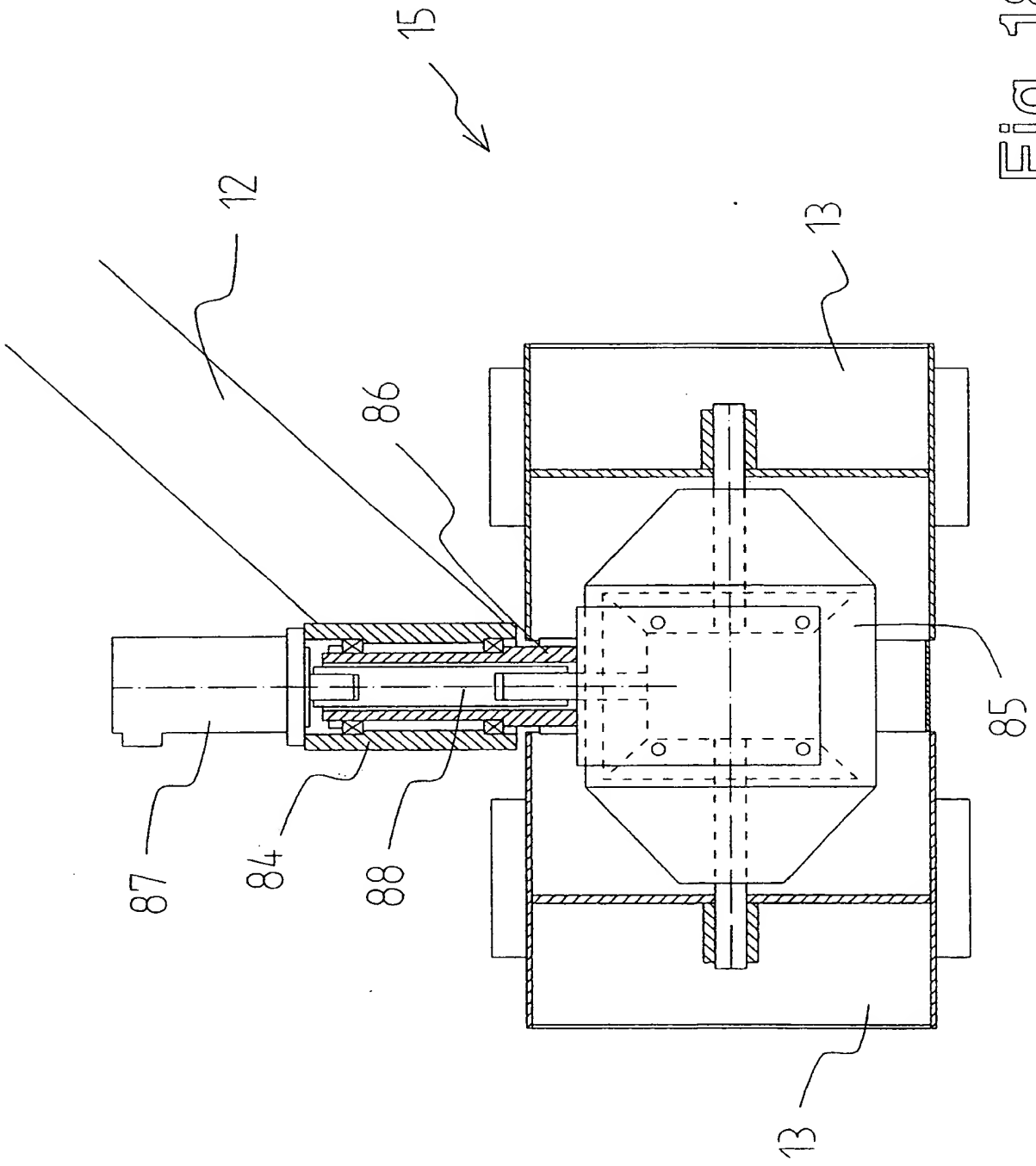


Fig. 18

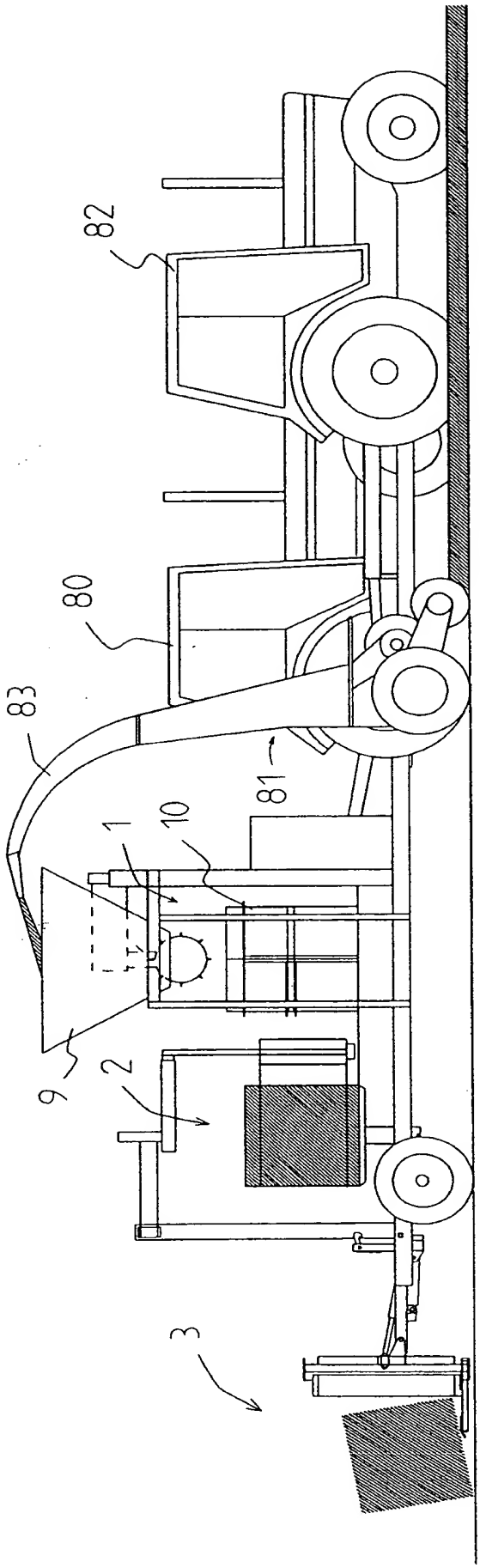


Fig. 21

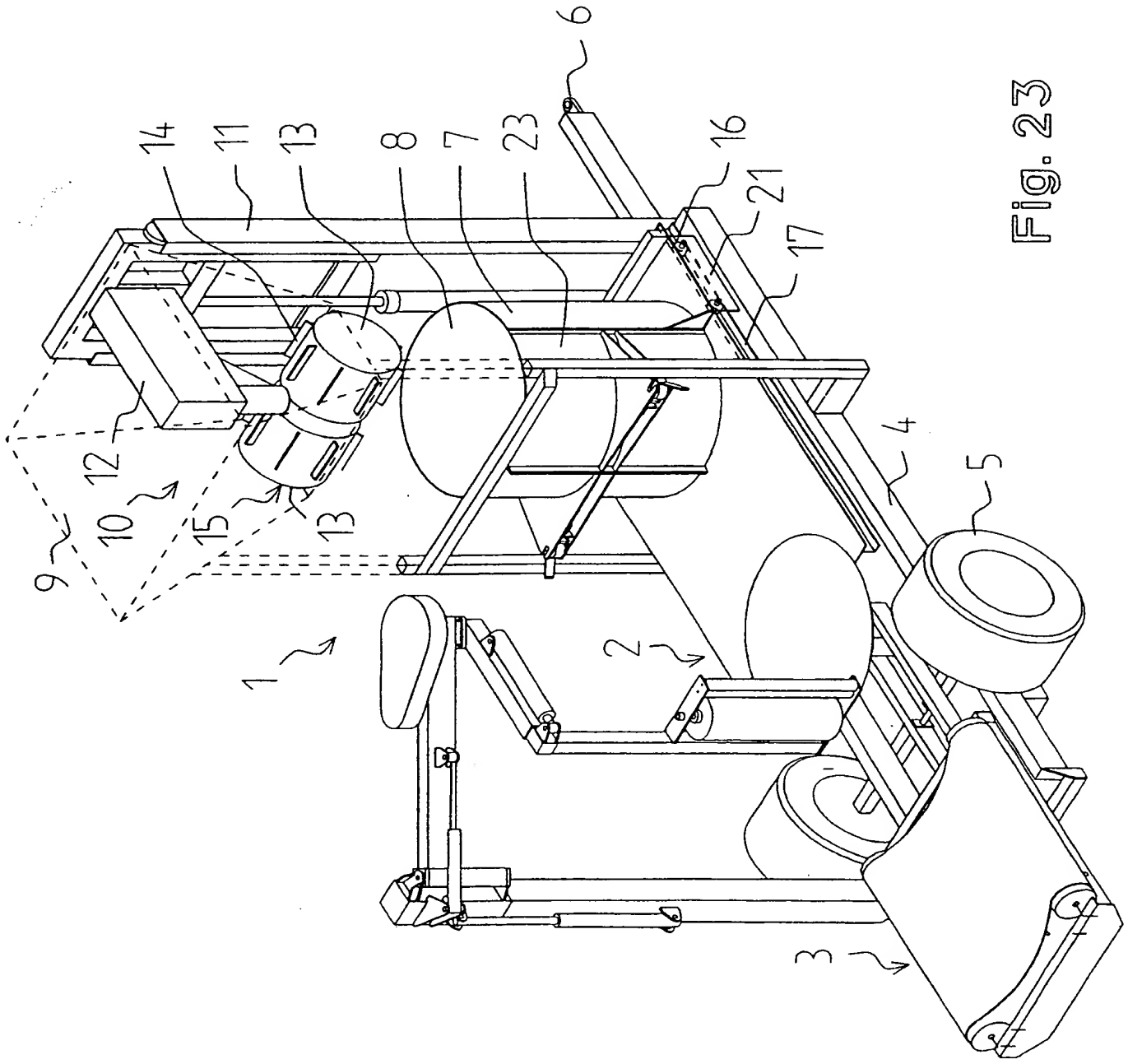


Fig. 23

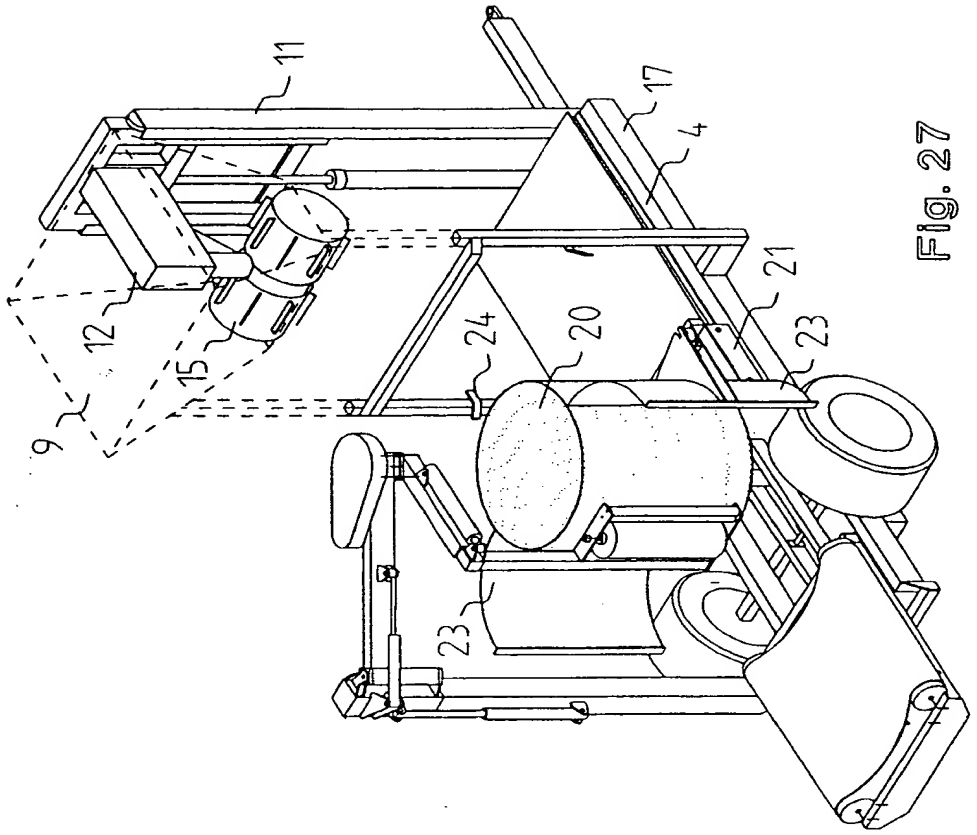

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Fig. 27

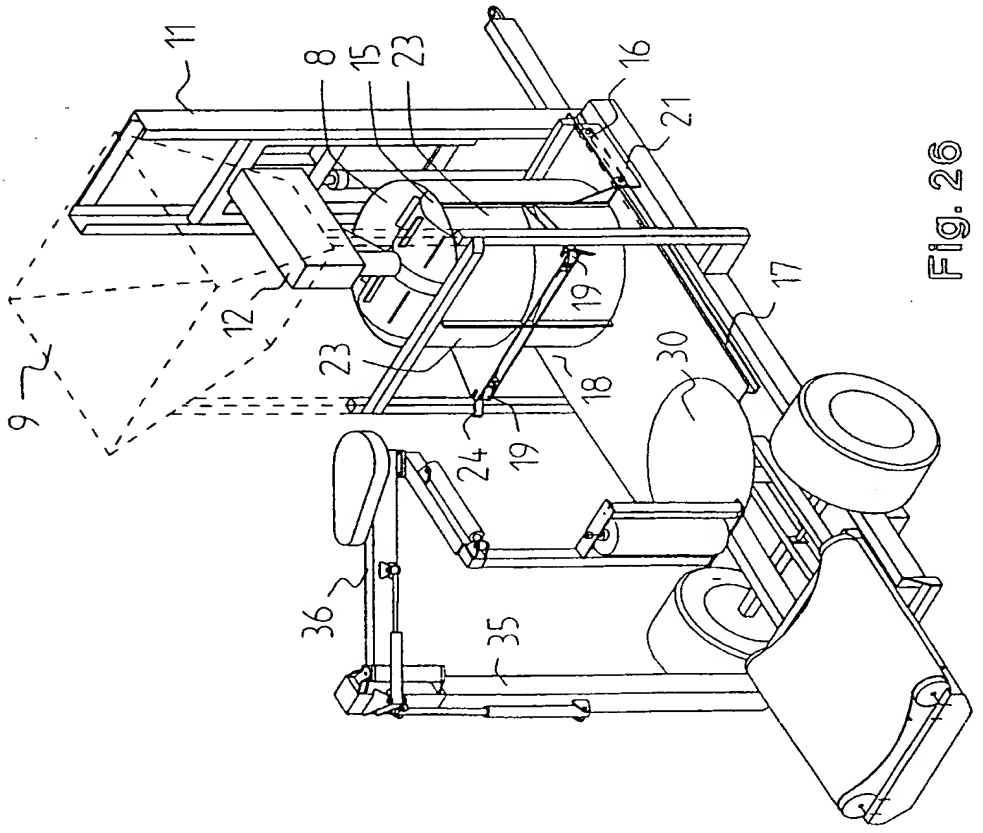
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Fig. 26

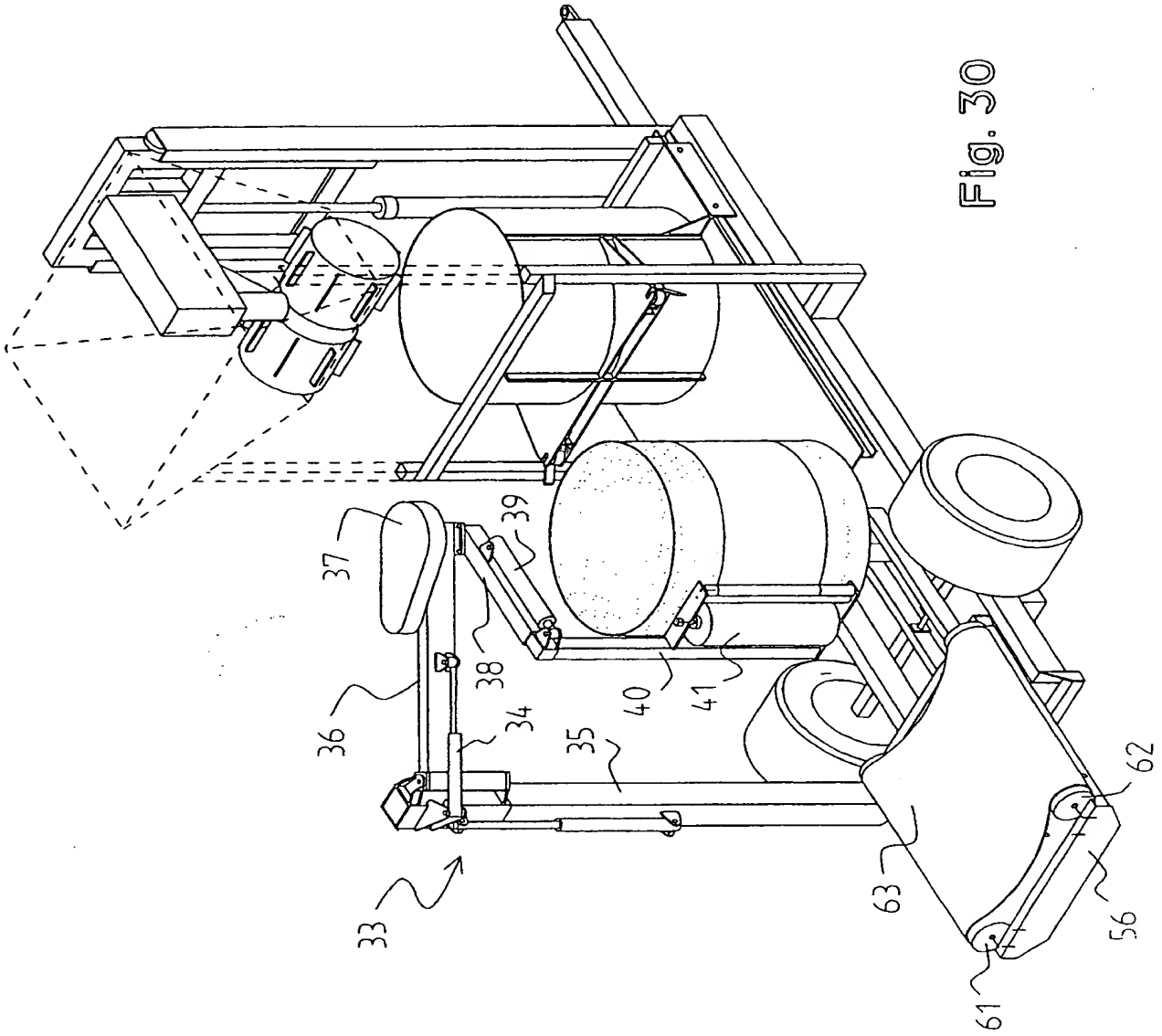

Fig. 30

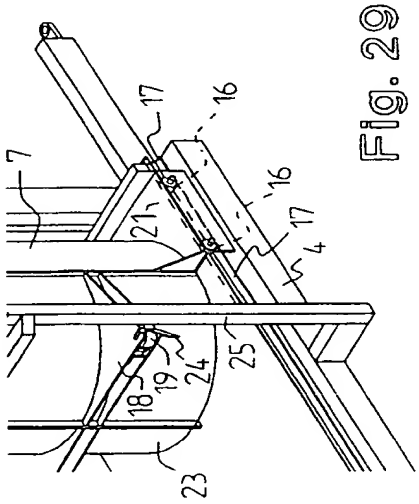

Fig. 29

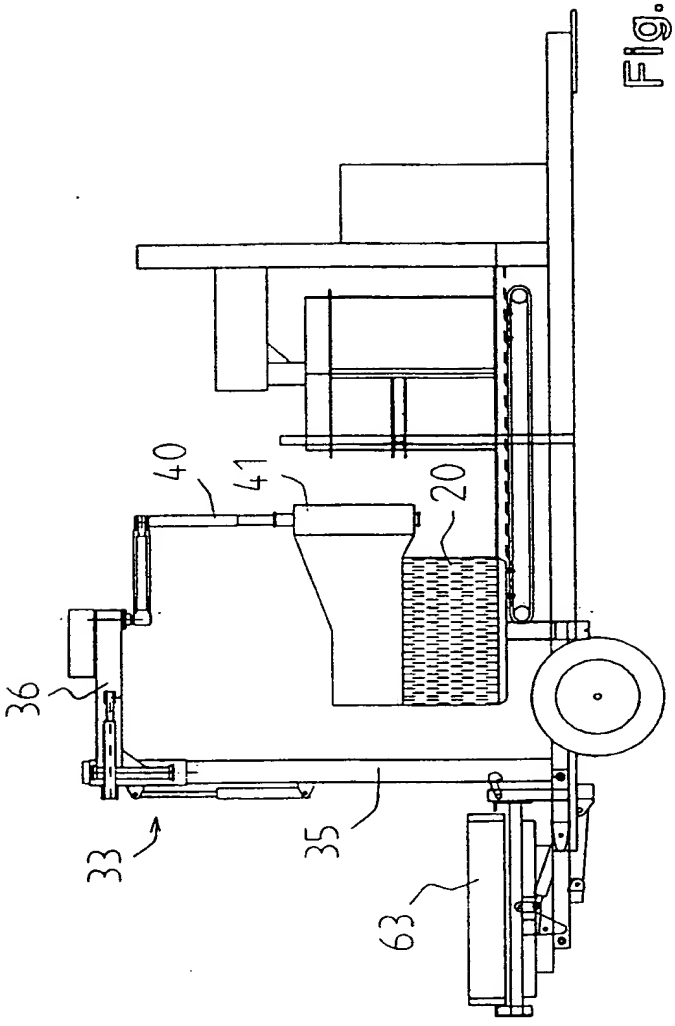

Fig. 32

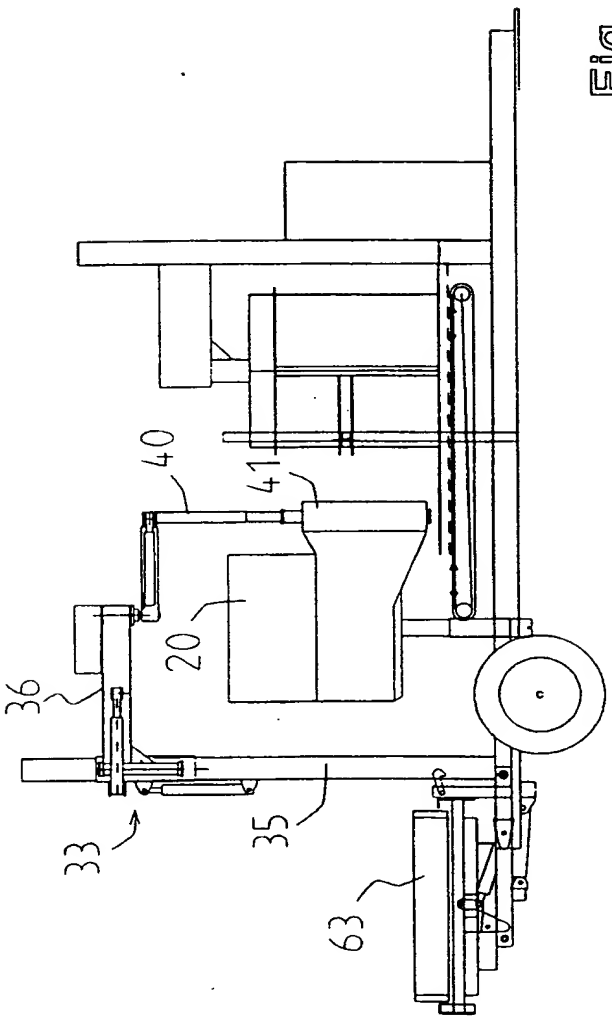

Fig. 33

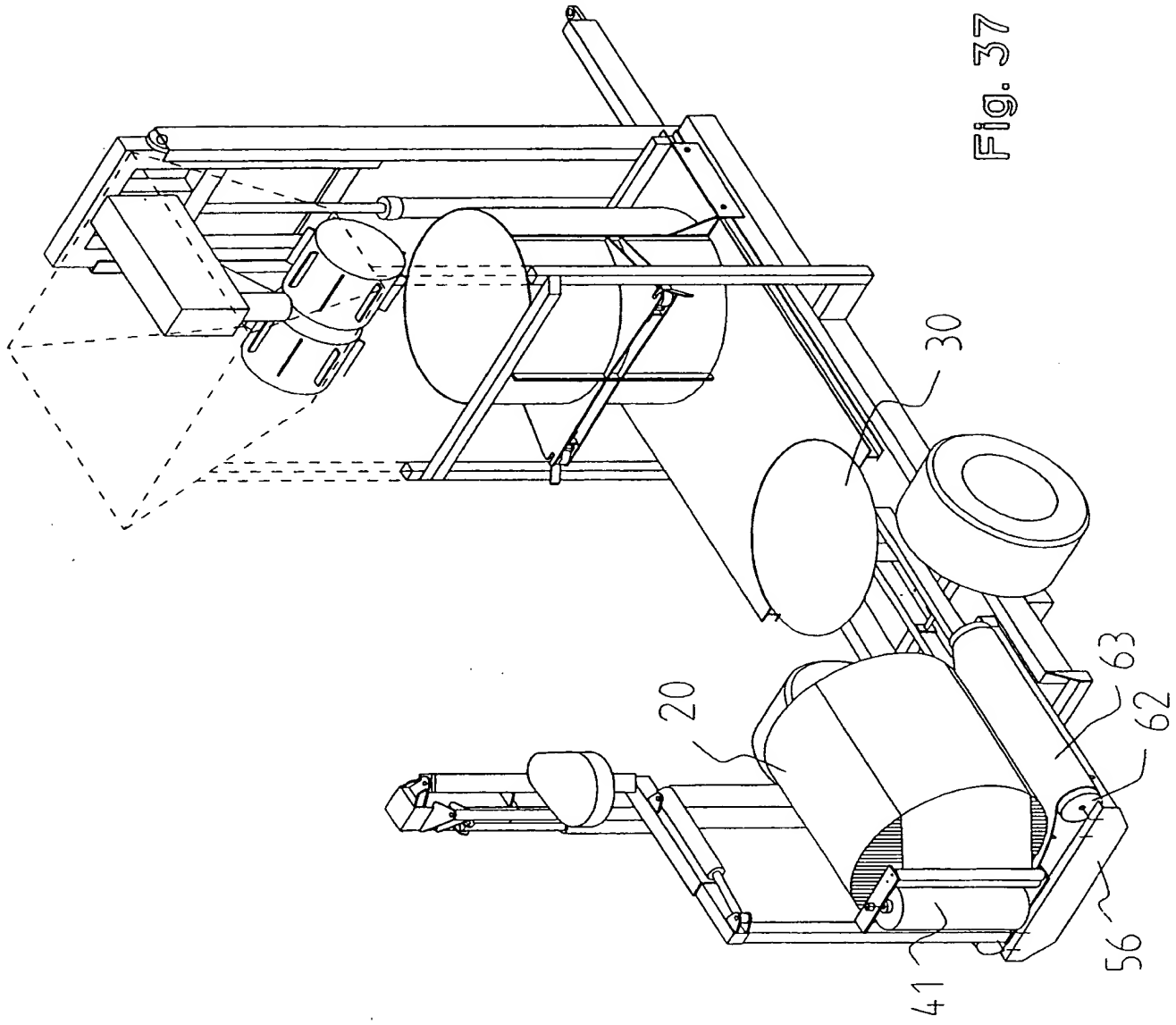

Fig. 37

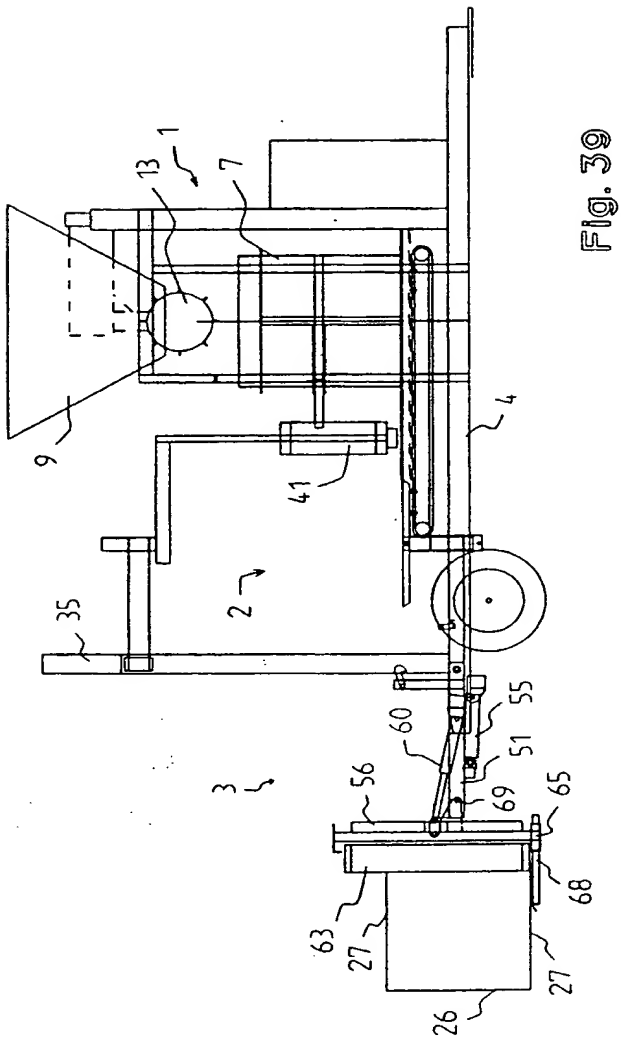
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Fig. 39

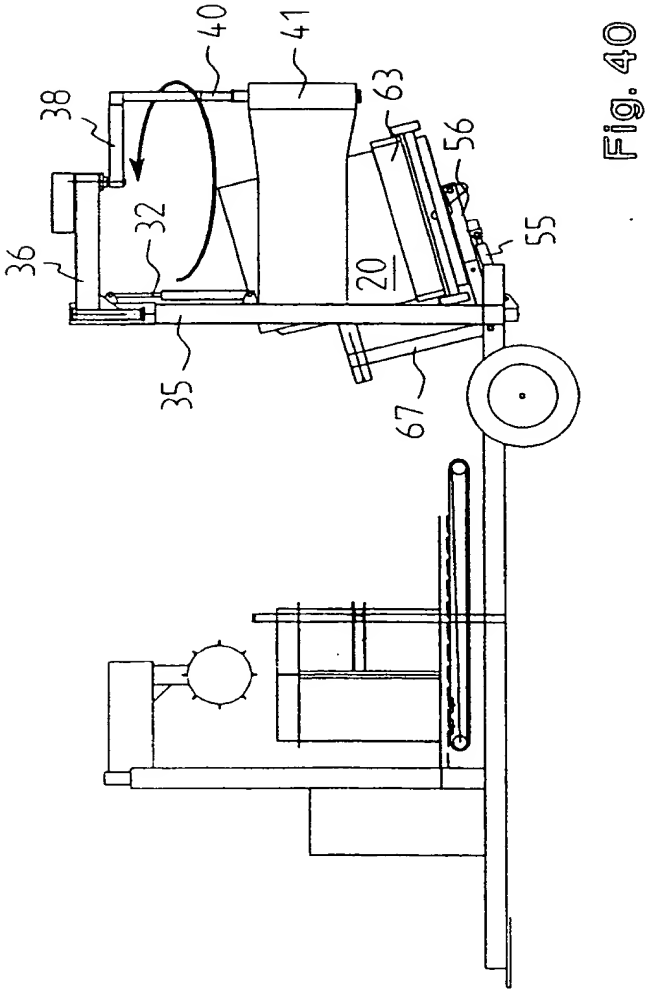
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Fig. 40

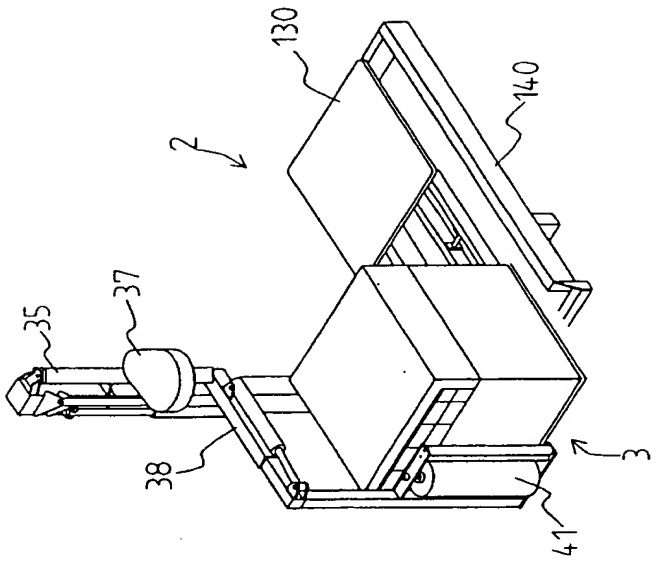

Fig. 45

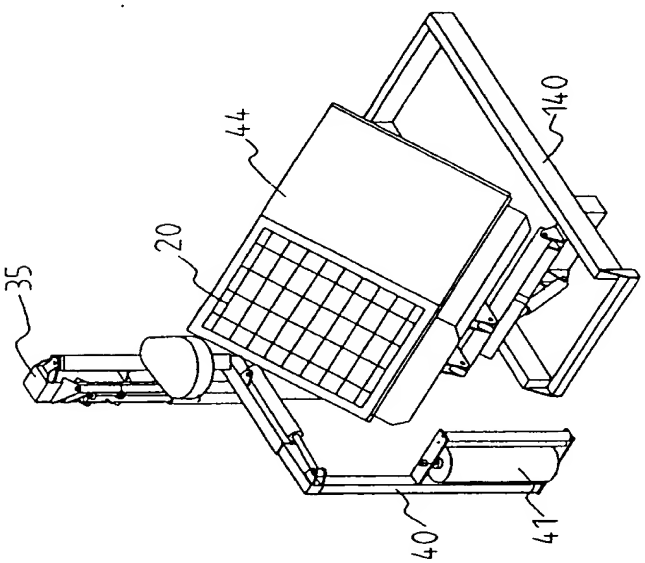

Fig. 44

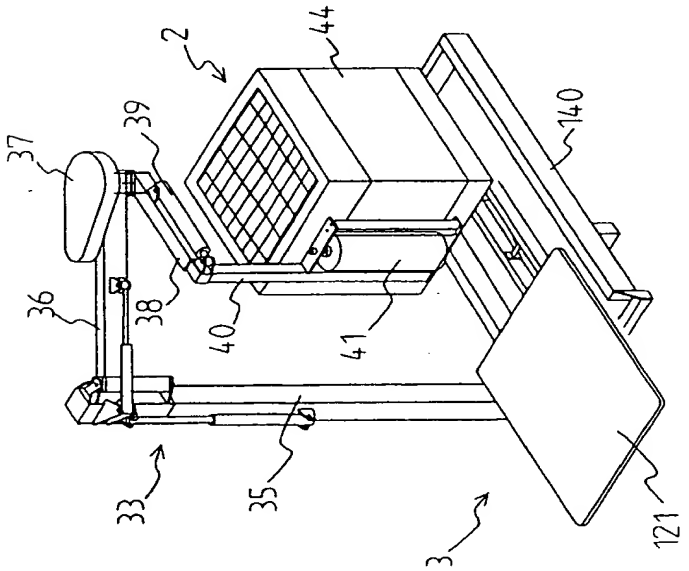

Fig. 43

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IE 98/00066

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01F15/07 B65B11/04

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01F B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 40 37 533 A (SCHENKE) 27 May 1992 see column 1, line 28 - column 2, line 63; figures 1-4	1-4,12, 13,15
X	WO 94 01997 A (KVERNELAND) 3 February 1994 see page 9, paragraph 10 - page 18, paragraph 2; figures 1-5	1,2,4, 12,13
A	DE 40 16 424 A (SCHENKE) 28 November 1991 see column 1, line 56 - column 3, line 4; figures 1,2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 November 1998	25/11/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vermander, R

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